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Diploma Programme subject in which this extended essay is registered: GEOGRAPHY

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Title of the extended essay: To what extent is the Township of Langley's corporate waste management program effective, demonstrating environmental sustainability?

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exhibited an impeccable work ethic as well as considerable enthusiasm and creativity while working on his extended essay. He independently created a very well thought out plan for ~~carry~~ researching his topic, and carried it out with great success.

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Assessment form (for examiner use only)

Criteria	Achievement level				
	Examiner 1	maximum	Examiner 2	maximum	Examiner 3
A research question	2	2		2	
B introduction	2	2		2	
C investigation	3	4		4	
D knowledge and understanding	3	4		4	
E reasoned argument	3	4		4	
F analysis and evaluation	3	4		4	
G use of subject language	4	4		4	
H conclusion	2	2		2	
I formal presentation	4	4		4	
J abstract	2	2		2	
K holistic judgment	2	4		4	
Total out of 36	30				

Investigating the Effectiveness of the Township of Langley's Corporate Recycling and Waste Reduction Program.

To what extent is the Township of Langley's corporate waste management program effective, demonstrating environmental sustainability?

Candidate Number:
School Name:

School Number:
Extended Essay: Geography
Session: May 2013
Word Count: 3,952

Abstract

This extended essay investigates the effectiveness of the Township of Langley's (British Columbia, Canada) corporate recycling and waste reduction program., called *Responsible*. Thus, the research question of this extended essay is "**To what extent is the Township of Langley's corporate waste management program effective, demonstrating environmental sustainability.**" The hypothesis of this essay is that *Responsible* is not an effective waste management program because it is a fairly new program that will need to make improvements. In order to investigate the effectiveness of *Responsible*, a waste classification analysis was done on four-stream waste containers from four various recreation centres (W.C. Blair, Walnut Grove, Civic Facility, Langley Events Centre) in the Township of Langley. A total of 16 garbage bags were collected and analyzed by separating the waste in each bag into the four categories of the waste containers (containers, paper, food, and garbage). Along with this primary data, census reports from both the Canadian government and Township of Langley's municipal government regarding population growth and density was looked at. The results of the waste classification analysis showed that *Responsible* had a correct composition of 76.31%. One could generalize this result to 3 out of 4 pieces of waste in the *Responsible* waste bins are placed in the correct category. Despite a fairly accurate composition result, the hypothesis was rejected because in order for the *Responsible* program to be effective, it needs to have a 100% correct composition rate. As a result, the Township of Langley's waste management program does not exemplify environmental sustainability, but has the potential to be an effective program in the future. The generalizability of this extended essay is very limited because of the small data sample. However, The results of this study does provide a starting point for future improvements on the *Responsible* program.

[Abstract Word Count: 297]

Acknowledgements

I would like to sincerely thank my Extended Essay Supervisor , for his enthusiasm to always guide me in writing and researching this essay. I would also like to thank , the Solid Waste Coordinator at the Township of Langley, who was instrumental in allowing me to gather my primary data and other information relating to the waste management system of the Township of Langley. Along with , I would like to thank the Facility Coordinators of the Walnut Grove Community Centre, W.C. Blair Recreation Centre, Langley Events Centre, and the Civic Facility, who generously permitted me to gather data from the various recreation centres. The generosity of all these individuals has made the whole process possible. Thank you.

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Introduction

Background of Environmental Sustainability

The United Nation's 7th Millennium Development Goal Target 7.A is to "integrate the principles of sustainable development into country policies and programs and reverse the loss of environmental resources[1]". This target falls under Goal 7[2], which is to ensure environmental sustainability. Sustainability, as defined in 1987 by the World Commission on Environment and Development, is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs[3]". Along with this definition, the United Nation's (UN) *Three Pillar Model*[4] (Figure 1) of sustainability was created; a balance between economic development, social equity development, and environmental protection is the most ideal environment, which results in sustainability.

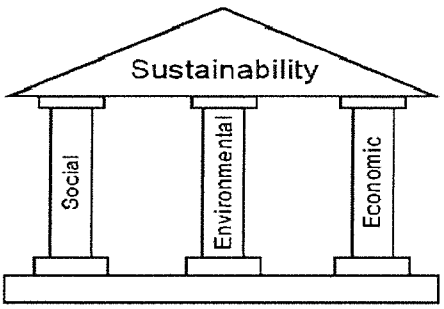

Figure 1.1. UN Three Pillar Model of Sustainability[5]

This essay focuses on one of the three pillars: environmental sustainability. Herman Daly, an American ecological economist suggested a criteria that outlines how environmental sustainability is achieved. Herman Daly's theory (Figure 1.2.) is effective and is a standard basis for studies relating to sustainability.

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[1] United Nations. United Nations Development Programme.*GOAL 7: ENSURE ENVIRONMENTAL SUSTAINABILITY*. New York: , 2000. Web. <http://www.un.org/millenniumgoals/environ.shtml>.

[2] United Nations. United Nations Development Programme.*GOAL 7: ENSURE ENVIRONMENTAL SUSTAINABILITY*. New York: , 2000. Web. <http://www.un.org/millenniumgoals/environ.shtml>.

[3] World Bank group. *What is Sustainable Development*. Washington: , 2001. Web. <http://www.worldbank.org/depweb/english/sd.html>.

[4] United Nations . Office of the President of the General Assembly. *Sustainable Development* . New York: , 2010. Web. <http://www.un.org/en/ga/president/65/issues/sustdev.shtml>.

[5] Harick, Jack. *The Three Pillars of Sustainability*. N.d. Graphic. Thwink.org, Clarkston. Web. 18 Aug 2012. <http://www.thwink.org/sustain/glossary/images/ThreePillars_ArchitecturalSimple.png>.

1. For Renewable Resources, the rate of harvest should not exceed the rate of regeneration (sustainable yield);
2. [For Pollution] The rates of waste generation from projects should not exceed the assimilative capacity of the environment (sustainable waste disposal); and
3. For Nonrenewable Resources the depletion of the nonrenewable resources should require comparable development of renewable substitutes for that resource.

Figure 1.2.[6] Herman Daly's Definition of Environmental Sustainability

Environmental sustainability can be achieved through many different methods, including monitoring of air quality, reducing deforestation, using green technology, implementing renewable energy, or integrating an effective waste management program. Having a proper waste management system ensures that recyclable materials are being recycled as much as possible (uses less future resources), land is not being filled by waste that could be recycled, water sources are not contaminated, soil nutrients are replenished (composting), and so on. Waste management can be implemented at the household level and corporate level. In order for governments to see successful results, policies need to be implemented at the national, provincial/state, and municipal level. This essay looks at the municipality of the Township of Langley's corporate recycling program called *Responsible*.

Geographical Context

The Township of Langley (TOL), also called the "Birthplace of B.C.", is a municipality that consists of six different communities. The Township is located in the southern west section of British Columbia, Canada. Being a suburban area, the TOL is quickly developing and modernizing its infrastructure to match the growth of the population (largely due to immigration). The Township though, still maintains its rural aspects by specifying 75% of the TOL land to an Agricultural Land Reserve[7]. However, when municipalities start to urbanize, environmental considerations are sometimes overlooked and/or not prioritized. Figure 1.3 below shows the expeditious growth of the TOL in comparison to larger regions, which can be beneficial economically, but not always environmentally.

[6] Daly, Herman. "Boundless Bull." *Toward some operational principles of sustainable development. Ecological Economics* . 4.3 (1990): 113-118. Web. 16 Sep. 2012. <http://www.thwink.org/sustain/glossary/EnvironmentalSustainability.htm>.
[7] Township of Langley. Community Development Division.*Overview*. Township of Langley: , 2011. Web. <http://www.tol.ca/About-the-Township/Overview>.

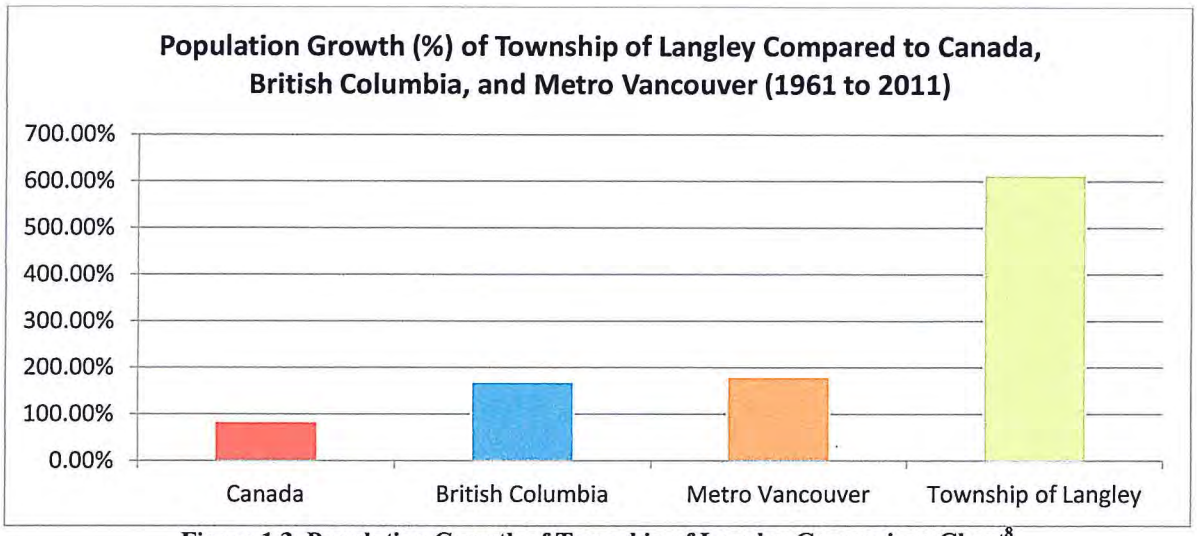

Figure 1.3. Population Growth of Township of Langley Comparison Chart[8]

As shown above, the population growth of the TOL is quite significant. Within 50 years, the Township's population increased by over 600% to have an estimated total of 106,332[9] people. It is crucial for communities to have an effective waste management program to ensure rapid development does not harm the natural environment. The possible impact on the environment as a result of population growth was outlined by Nobel Prize Recipient Paul Ehrlich. Ecologist Paul Ehrlich created the IPAT Equation theory[10] in the 1970s when questions about the causes of environmental impacts were discussed.

I = PAT
Impact (on Environment) = **P**opulation (size) x **A**ffluence (Consumption per person) x **T**echnology (damage per unit of consumption due to technology)

Figure 1.4 Ehrlich's IPAT Equation[11]

The original version of the equation, which generally sets **I** as CO_2 levels in the atmosphere, is sufficient enough to display the role that population size has on environmental harms. The equation shows that a greater population, will result in a higher impact on the environment. This is why it is crucial for the TOL, an expanding area, to ensure it sets an efficient waste management system to try to reduce inevitable environmental impacts as a result of a drastic increase in population. In addition to a multi-stream home waste management system,

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[8] Canada. Statistics Canada. *Census Population Growth in Township of Langley, Metro Vancouver, B.C., & Canada: 1961 to 2011.* Ottawa: , 2011. Web. <http://www.tol.ca/Services-Contact/Document-Library/fid/42>.

[9] Township of Langley. Community Development Division.*Communities and Neighbourhoods*. Township of Langley: , 2011. Web. <http://www.tol.ca/Land-Use-and-Development/Communities-Neighbourhoods>.

[10] Chertow, Marian . "The IPAT Equation and Its Variants; Changing Views of Technology and Environmental Impact." *Journal of Industrial Ecology*. 4.4 (2011): 13-29. Print.

[11] Chertow, Marian . "The IPAT Equation and Its Variants; Changing Views of Technology and Environmental Impact." Journal of Industrial Ecology. 4.4 (2011): 13-29. Print.

the TOL has recently (spring 2012) finished implementing a new corporate municipal waste management system called *Responsible*.

Responsible is a corporate waste management system that integrates multi-stream waste containers at municipal facilities, which include recreation centres. Multi-stream waste containers provide people with the option of placing their garbage in various categories of garbage, compared to a generic recycling bin or garbage bin (single-stream waste collection). The reason why the TOL uses multi-stream is because the residential program is also multi-stream. Households in Langley have a yellow bag for mixed paper, blue bag for newsprint, blue box for containers, and a "Green Can" for food disposals. Tess Rutley, the Solid Waste Coordinator says, "We wanted residents to have a smooth transition when they came to our facilities. Having everything the same process makes it much easier. They have to sort out their materials at home and also in the public spaces in their communities." (Appendix I)

Purpose

The purpose of this essay is to investigate the effectiveness of the Township of Langley's corporate recycling and waste reduction program. Environmental sustainability is becoming a significant concern for governments around the world as climate change is becoming a top priority. It is very important that this topic is looked at because waste management is an extensive factor in reducing environmental impacts. This essay takes an in-depth look into the *Responsible* program to provide analysis for possible future improvements and concerns.

Research Question

The research question of this essay is "To what extent is the Township of Langley's corporate waste management program effective, demonstrating environmental sustainability?"

For the scope of this essay, only Point 2 of Daly's definition will be looked at when defining environmental sustainability. Point 1 of his theory requires an analysis of the agricultural development rates of the TOL which was not analyzed. Point 3 deals with the amount of research and development put into finding renewable resources to substitute existing non-renewable ones, which is typically done at a national level of research. Thus, Point 2, which deals with sustainable waste disposal is the appropriate definition for the purpose of this essay. The definition links to waste management because in order for rates of waste disposal to not exceed the capacity of the environment, waste must be recycled as much as possible. The amount of waste going to landfills needs to be notably decreased. In this essay, the waste disposal is of the general public's because *Responsible* is a corporate program.

Hypothesis

The Township of Langley is a population-booming municipality that will see inevitable growth for the next few years. The final recreation centre implementation of *Responsible* was done this past summer (2012), and so, the corporate waste management system will have some obstacles it needs to overcome. *Responsible* is not expected to be an efficient program at such an early stage, thus, not demonstrating environmental sustainability. In order for *Responsible* to be a fully effective program, the correct composition percentage overall should be 100%. A 100% correct composition would mean that every possible waste that is recyclable or compostable is not being put into landfills, minimizing as much waste as possible. Expecting a 100% correct composition percentage is not reasonable at such a primal stage.

Location of Research

The location of research for this essay is the Township of Langley, British Columbia, Canada (Figure 1.5 & 1.6). Four identical multi-stream waste containers were taken from each of the following locations: Civic Facility (Willowbrook), Langley Events Centre (Willoughby), Walnut Grove Community Centre (Walnut Grove), and W.C. Blair Community Centre (Murrayville). The approximate total area of the general area including the four recreation centres (Figure 1.7) is 63.66 square kilometers.

Map Location of Township of Langley

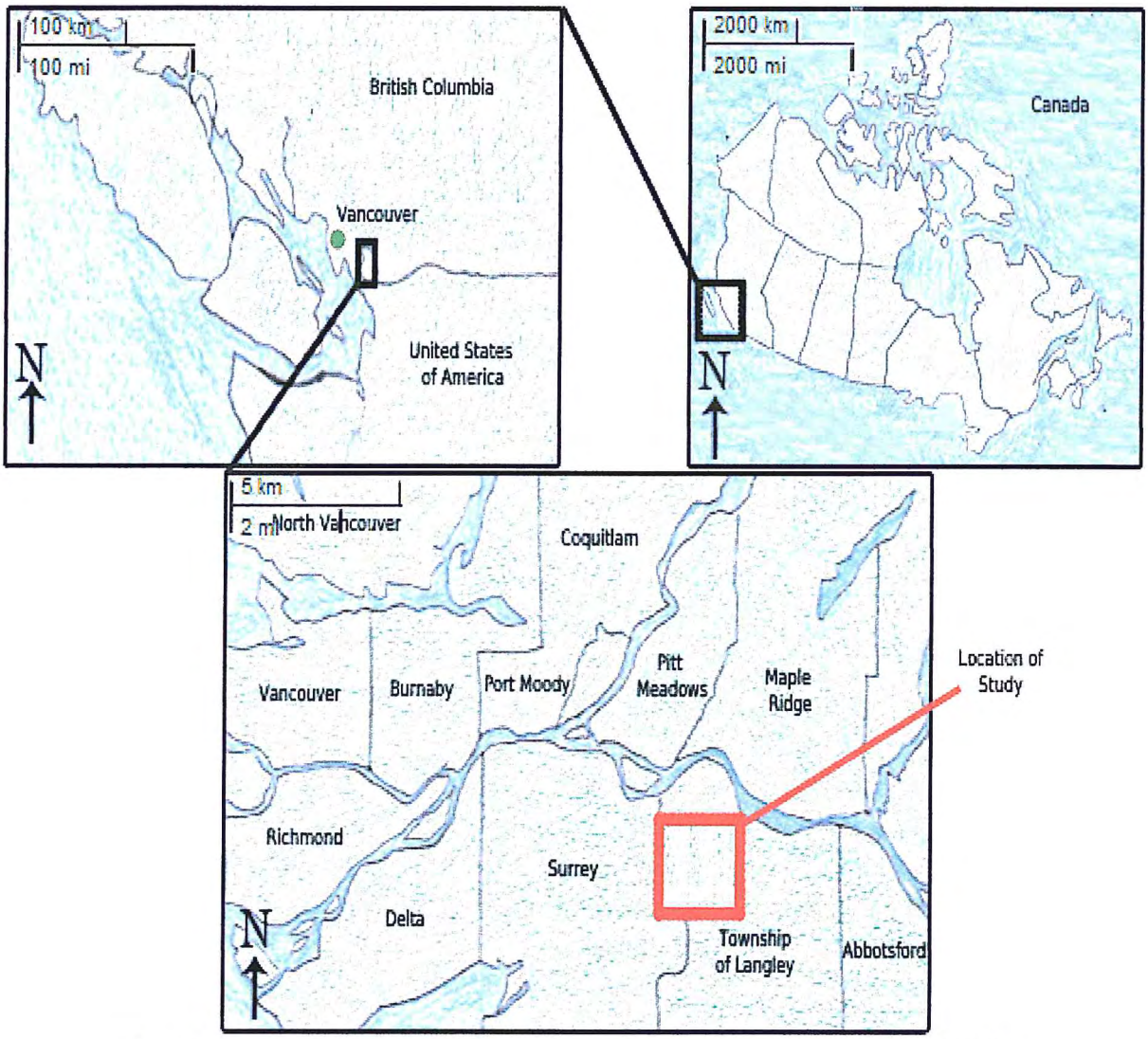


Figure 1.5 Location of Study in Perspective to Lower Mainland of B.C., and Canada (Referenced from TOL site and Google Maps)

Map of Specific Area of Study Location

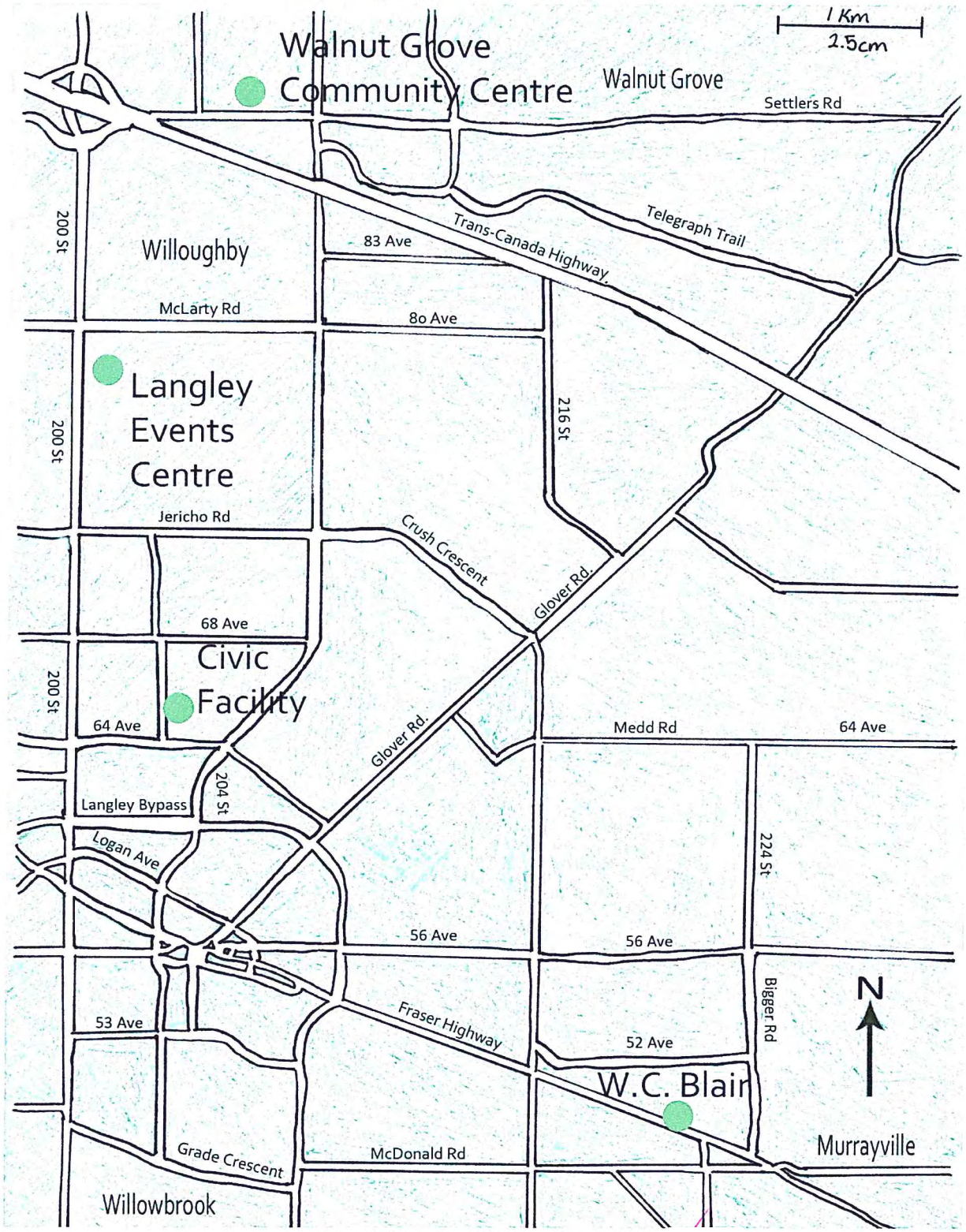


Figure 1.6 (Referenced from Google Maps)

Recreation Centres Sampled For Research

Figure 1.7 (From TOL site)[12]

[12] *Recreation Centres in Township of Langley*. N.d. Photograph. www.tol.ca, Township of Langley. Web. Aug 21 2012. < http://www.tol.ca/Parks-Recreation/Recreation-Centres>.

Method of Data Collection

Sampling Method

Convenience sampling was used for this research because of limitations on the accessibility of recreation centres. The four recreation centres that were investigated were provided and approved by the Solid Waste Coordinator and the respective recreation managers. Using convenience sampling is effective for this essay because the research is a pilot study. The TOL has never done a waste classification analysis of its recreation centres, and so for providing basic data, convenience sampling is useful.

Data Collection

The primary data of this research was obtained through a waste classification analysis of identical (eliminates appearance variable of containers) four-stream waste containers at Civic Facility (CF), Langley Events Centre (LEC), Walnut Grove Community Centre (WGCC), and W.C. Blair Community Centre (WCB), as shown below in Figure 2.1. More photos of the bins' locations can be seen in Appendix II

Figure 2.1 Multi-Stream Bins From Each Location (Photo taken from each location)

All 16 garbage bags (4 from each category of paper, containers, garbage, and food) were taken to R.E. Mountain Secondary to be separated and classified. The collection process was done within an hour to minimize the time variable as waste levels could differ at various times of the day. The waste inside the bags were all laid out on a table and each bag from each recreation centre was organized into how many of each category of waste was in the bag. For example, the ideal scenario would be to find 100% make-up of paper wastes in the paper waste bag. Every piece of garbage was assumed as one piece of waste, no matter what size. As for food scraps and other items that were broken in pieces, judgment was used to label items as a "part of one" or a separate piece. Time constraints played a role in the ability to go into specific detailed counting of every scrap of waste. The mean of all of classifications will be taken to see if there is a general trend in how effective *Responsible* is. After completing the classification, the waste was taken back to the TOL waste facility where each category of waste was disposed into its appropriate location.

Other sources of primary data include government census statistics and direct information from the Solid Waste Coordinator through e-mails for clarifications of certain aspects of *Responsible*. Government statistics provide geographical context and can lead to various factors influencing the data in the analysis section.

Secondary data is mainly used for providing models and theories relating to the topic of environmental sustainability. It is crucial that secondary data is looked at to validate or disprove the primary data to avoid researcher bias. By using both primary and secondary data, the validity of the essay is increased.

Data Presentation

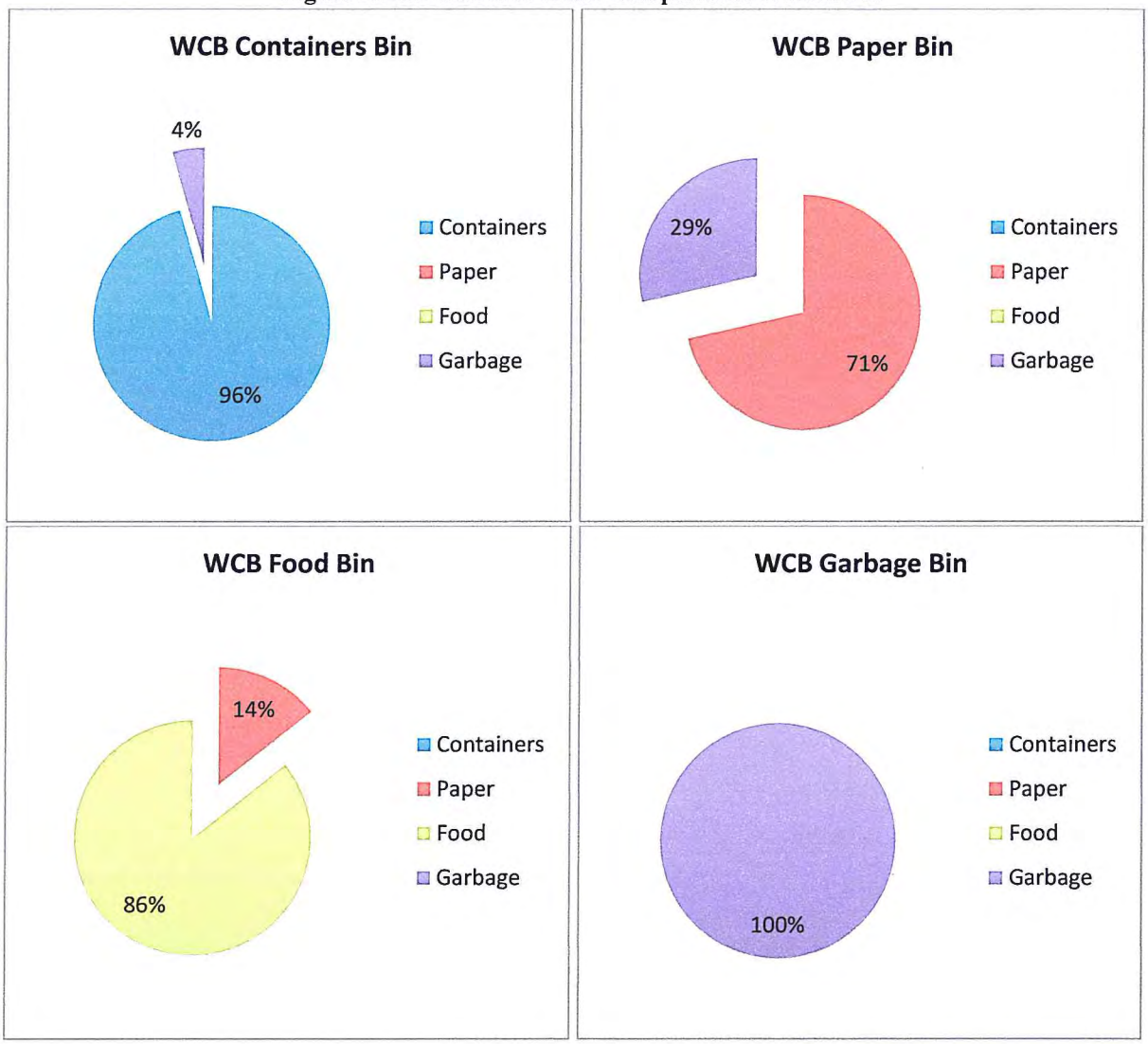
The following data table shows the raw data of the contents of each waste bag. The total amount of items in each bag is displayed to provide a general idea of the total amount of waste in each bin and location.

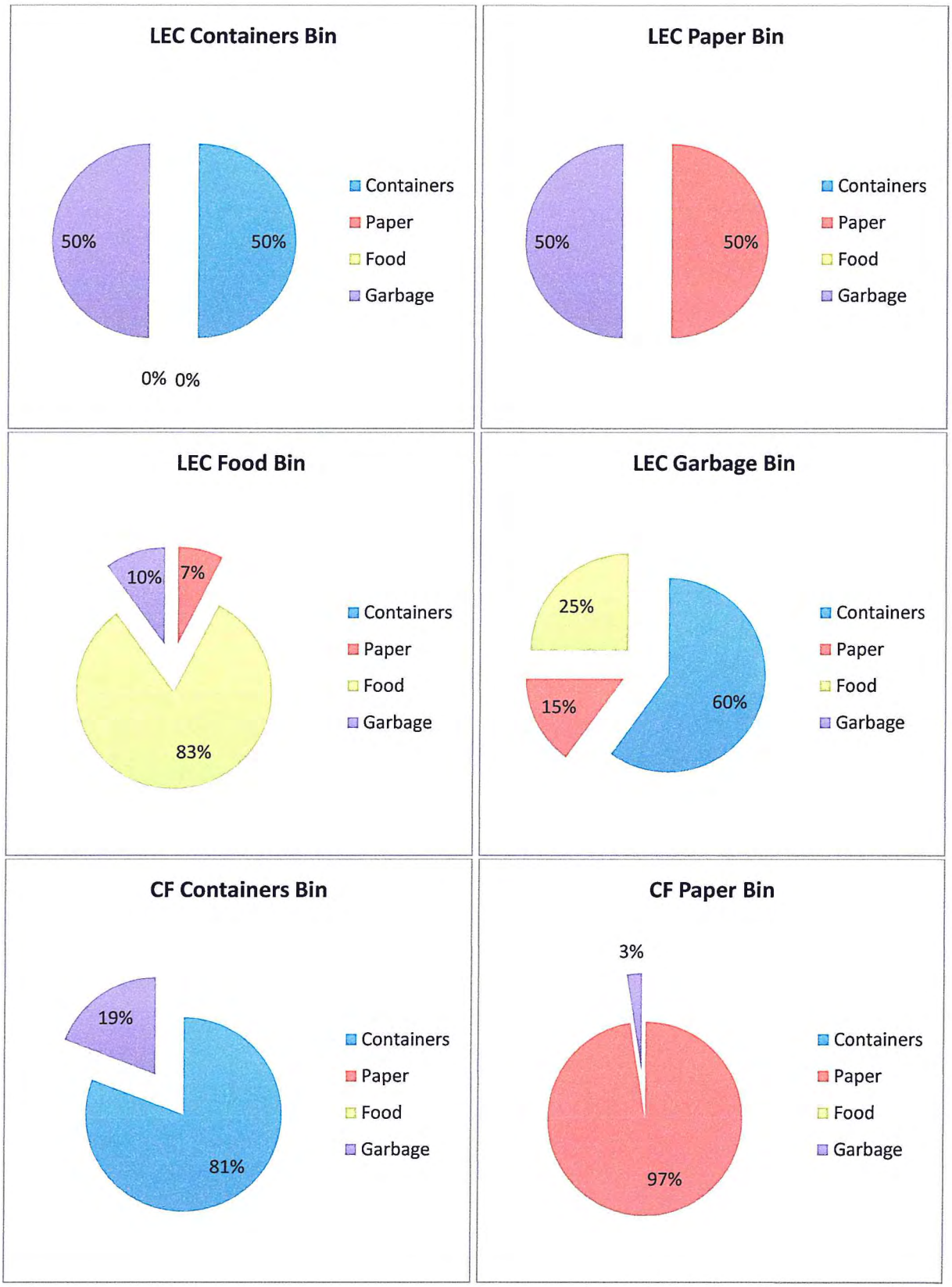
Raw Data Table					
W.C. Blair					
	Composition of Waste (Number of Items)				**Total**
Waste Category (Bins)	Containers	Paper Items	Food Items	Garbage Items	
Containers	22	0	0	1	**23**
Paper	0	10	1	4	**14**
Food	0	1	6	0	**7**
Garbage	0	0	0	1	**1**
Langley Events Centre					
	Composition of Waste (Number of Items)				**Total**
Waste Category	Containers	Paper Items	Food Items	Garbage Items	
Containers	4	0	0	4	**8**
Paper	0	1	0	1	**2**
Food	0	3	33	4	**40**
Garbage	12	3	5	0	**20**
Civic Facility					
	Composition of Waste (Number of Items)				**Total**
Waste Category	Containers	Paper Items	Food Items	Garbage Items	
Containers	38	0	0	9	**47**
Paper	0	39	0	1	**40**
Food	0	0	1	0	**1**
Garbage	3	0	5	45	**53**
Walnut Grove Community Centre					
	Composition of Waste (Number of Items)				**Total**
Waste Category	Containers	Paper Items	Food Items	Garbage Items	
Containers	13	0	0	4	**17**
Paper	0	38	0	5	**43**
Food	0	9	578	8	**595**
Garbage	16	90	17	223	**346**

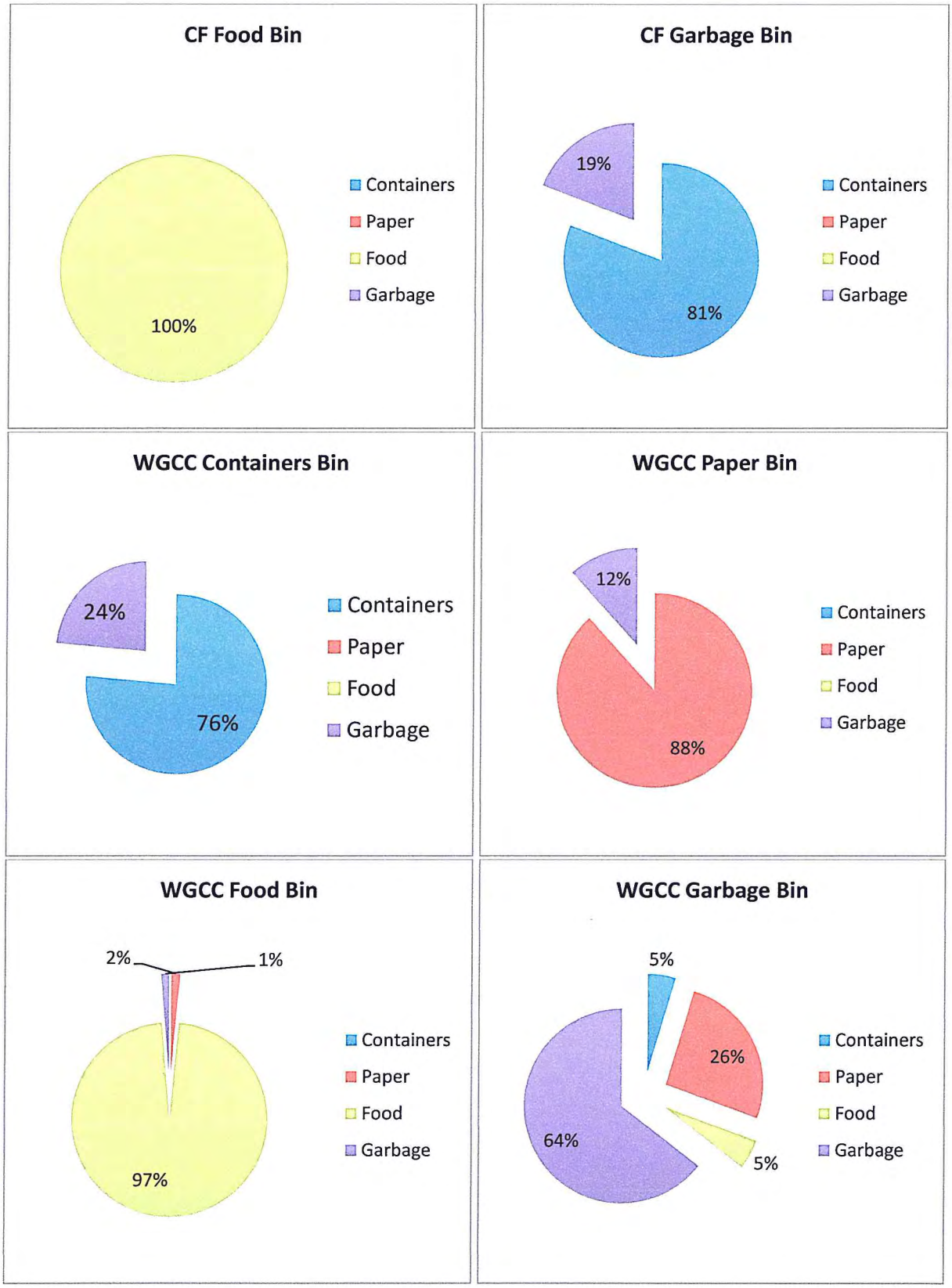
Figure 2.2 Data of Content Breakdown Per Garbage Bin

The following pie charts clearly illustrate the compositions of each waste bin. It should be noted that the percentages may be misleading; the WCB Garbage Bin chart shows 100% correct composition, but in Figure 2.2, it shows that there was only 1 item.

Figure 2.3 Pie Charts of Waste Compositions of Each Bin




LEC Containers Bin
50%
50%
0% 0%
Containers
Paper
Food
Garbage
LEC Paper Bin
50%
50%
Containers
Paper
Food
Garbage
LEC Food Bin
10%
7%
83%
Containers
Paper
Food
Garbage
LEC Garbage Bin
25%
15%
60%
Containers
Paper
Food
Garbage
CF Containers Bin
19%
81%
Containers
Paper
Food
Garbage
CF Paper Bin
3%
97%
Containers
Paper
Food
Garbage


CF Food Bin
100%
Containers
Paper
Food
Garbage
CF Garbage Bin
19%
81%
Containers
Paper
Food
Garbage
WGCC Containers Bin
24%
76%
Containers
Paper
Food
Garbage
WGCC Paper Bin
12%
88%
Containers
Paper
Food
Garbage
WGCC Food Bin
2%
1%
97%
Containers
Paper
Food
Garbage
WGCC Garbage Bin
5%
26%
64%
5%
Containers
Paper
Food
Garbage

The scatterered graph below shows the general composition of each waste category by having a calculated mean of composition accuracy. The ideal trendline would be at 100% with a slope of 0, but the data shows the trendline generally between the 70%~80% range. The mean of the accuracy of all the categories is 76.31%.

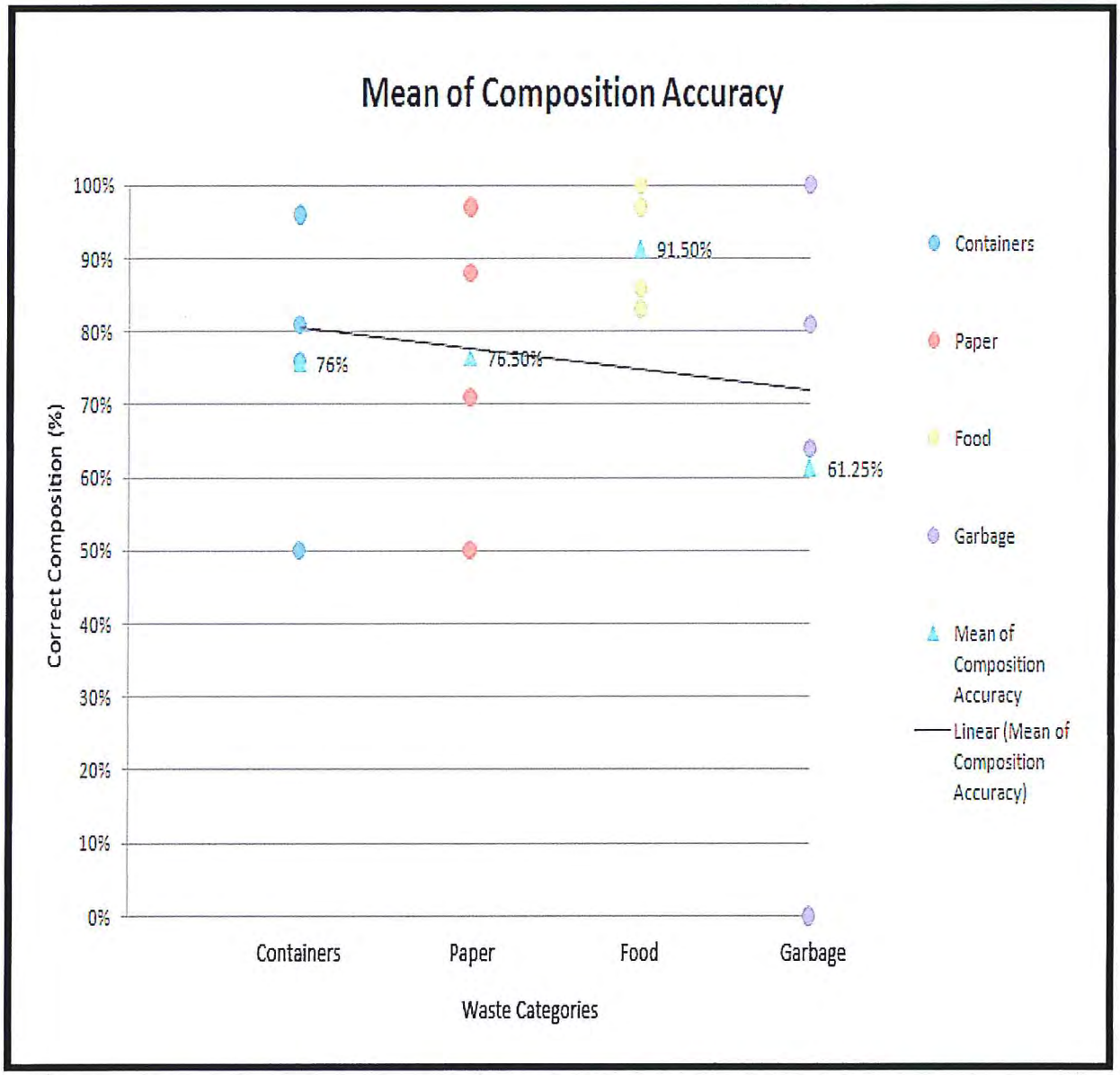


Figure 2.4 Mean of Composition Accuracy

The scatter graph below (Figure 2.5) compares the correct waste composition percentage of each community to the population size[13] to look for a relationship. The LEC and CF data is combined because the TOL's population data combines the population size of Willoughby and Willowbrook.

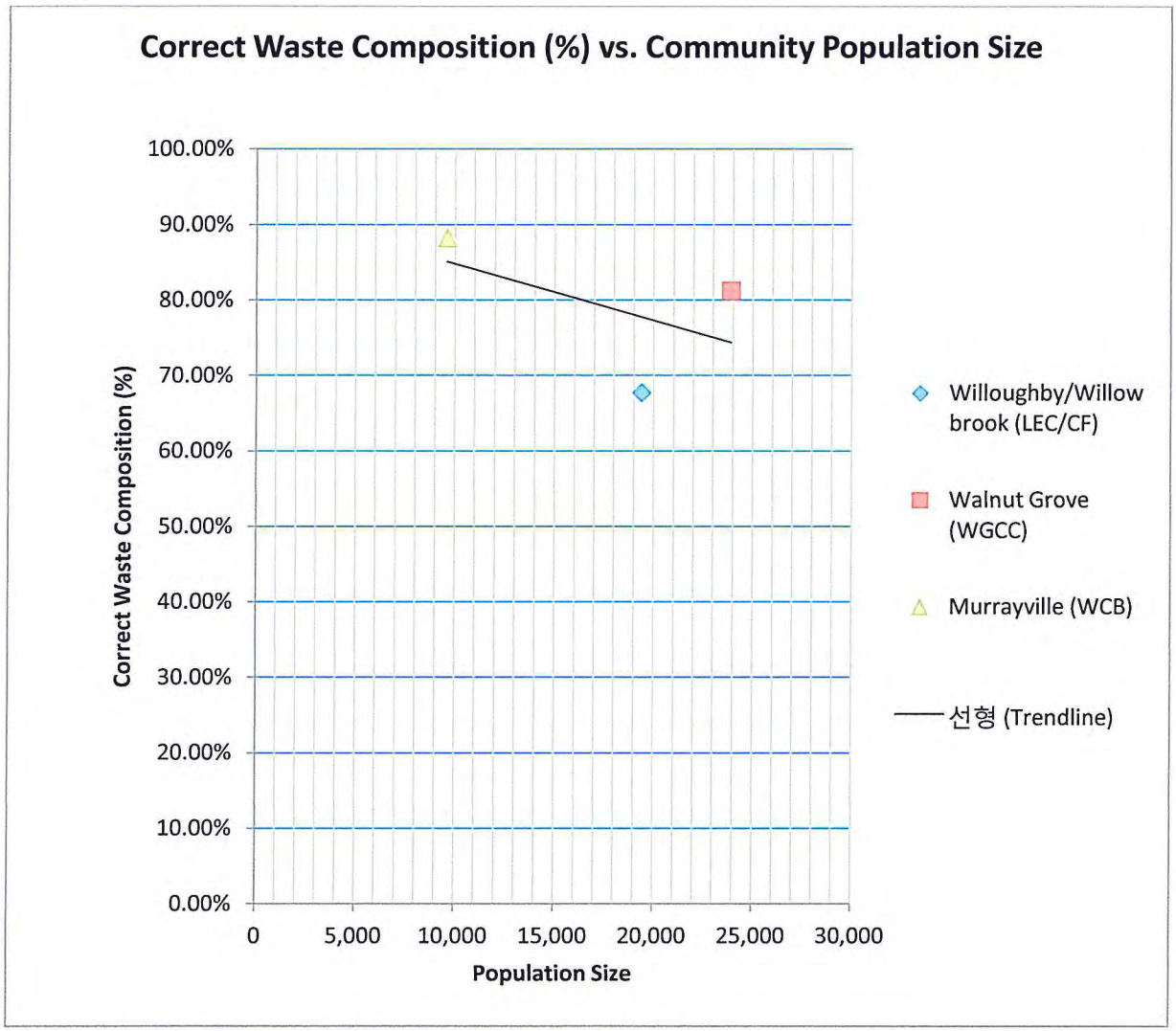


Figure 2.5 Relationship between correct waste composition and community population size

[13] Township of Langley. Community Development Division.*Communities and Neighbourhoods*. Township of Langley: , 2011. Web. <http://www.tol.ca/Land-Use-and-Development/Communities-Neighbourhoods>.

Data Analysis

Measure of Dispersion - Standard Deviation

$$\bar{X} = \frac{\sum X}{n} = \frac{76 + 76.50 + 91.50 + 61.25}{4} = 76.31$$

Data (X)	$X - \bar{X}$	$(X - \bar{X})^2$
76	-0.31	0.10
76.50	0.19	0.04
91.50	15.19	230.66
61.25	-15.06	226.88

$$\sum (X - \bar{X})^2 = \quad 0.10 + 0.04 + 230.66 + 226.88 = \mathbf{457.67}$$

$$s = \sqrt{\frac{\sum (X - \bar{X})^2}{n - 1}}$$

$$s = \sqrt{\frac{457.67}{4 - 1}}$$

$$s = \sqrt{\frac{457.67}{3}}$$

$$s = \sqrt{152.56}$$

$$s = 12.35$$

Figure 3.1 Standard Deviation Calculation of the Means of Accuracy of Each Waste Category

An essential part of data analysis is to see how accurate the mean is when representing all of the data. One method is to use standard deviation calculations to see the amount of variation from the mean of the data. The calculated standard deviation of the means of each category of waste is 12.35 as shown in Figure 3.1. In the context of this research, a standard deviation of 12.35 suggests that there is a fairly significant difference in the effectiveness of each waste

category. The order from most accurate to least accurate waste category is as follows: food (91.50%), paper (76.50%), containers (76%), and garbage (61.25%).

Explanation of Varying Accuracy of Waste Categories

A possible explanation for the above results is that the general population is not familiar with the system yet or people simply do not have the time to sort their waste. Out of all the categories, one could argue that food would be the easiest waste category to use. Appendix III shows the signs of each bin. The category of food scraps seems to be the most straightforward because there is no second guesses as to where food would go. Most of the misplaced waste in the food bin was mainly from food wraps which are paper category (perhaps due to lack of time or laziness). However, at a 91.50% correct rate, people seem to be separating their food scraps from the containers. The remaining three waste bins, though, have a slightly more complicated system. Between containers and garbage, there are various plastic codes that are acceptable in one, but not the other. Some people may not be familiar with which containers are what code or even with how to find plastic codes on a container. The coding of plastic container types may be a whole new idea to some, leading to the results of misplacement of waste. Figure 2.3 clearly shows that the garbage waste bin is primarily disrupted by containers, and vice versa. Furthermore, all of the coffee cups in the container bin still had lids on (Appendix IV). This is a perfect example of how human laziness or lack of time can be a significant contributor to waste contamination. Compared to history, people are wanting things faster and thus are becoming inclined to faster lifestyles. The increase in internet and cellular data speed are perfect examples of the evolution of the demand of speed. An interesting note to point out is that the TOL is implementing a school-wide three-stream waste system in the Fall of 2012. By integrating students into a multi-stream waste system at a young age, perhaps the habit of separating waste will become more natural to some.

Population vs. Correct Waste Composition

Ehrlich's model of environmental impact states that a greater population will result in a higher environmental impact. The higher the population in a community, the higher the consumption rate, and thus the higher amount of waste. Figure 2.5 attempts to find a relationship between population and correct disposing of waste. Although there seems to be a negative correlation relationship (due to the negative-slope trend line), the data is not consistent enough to establish a relationship. Willoughby/Willowbrook has the second largest population size out of the sample, but has the worst correct composition percentage. However, if the trend line is accepted, it fully supports Ehrlich's equation because Murrayville has the smallest population in the sample and has the most accurate composition rate. It shows that the larger a population gets, the less accurate the waste composition will get, leading to greater environmental impacts. This statement is the most plausible because the larger a population, the more difficult it is to have

consistent results. Also, the main reason for the dramatic increase in population in TOL is due to immigration. Some migrants that come to Langley may not be coming from countries that have a strict recycling system, especially from less economically developed countries. For these migrants, it would be harder to change from a typical one-stream waste system to a multi-stream waste system.

Anomalies

The LEC's garbage category bin had a composition of 25% food, 15% paper, 60% containers, and 0% garbage. Considering the fact that there were 20 pieces of waste in the bin, this is an anomaly. There is no definite cause of this, but some possible contributing factors, as mentioned before, could be: laziness, lack of time (people in a hurry tend to stick to the common "garbage" category), not being familiar with the multi-stream system, and etc.

Conclusion

The two main concerns of this essay are: 1) The effectiveness of the TOL's corporate *Responsible* waste management system and 2) The demonstration of environmental sustainability as a result of this program.

Responsible had an overall 76.31% correct composition percentage with a standard deviation of 12.35%. This means that generally, 3 out of 4 pieces of waste in TOL's *Responsible* bins are in the correct category of disposal. In order to reject the hypothesis, the waste composition should be at 100% efficiency, but is not. Thus, the hypothesis is accepted because *Responsible* is not effective to the point where it minimizes all possible waste. Referring back to Figure 1.2, the definition of environmental sustainability is, " The rates of waste generation from projects should not exceed the assimilative capacity of the environment (sustainable waste disposal);" In order to become as close as possible to this definition, the TOL corporate *Responsible* program should meet a 100% correct composition rate.

Although the TOL's *Responsible* program does not exemplify an environmentally sustainable society, the results of this research shouldn't discourage future improvements and studies. A 76.31% correct waste composition rate is a tremendous improvement compared to single-stream waste systems that have higher amounts of garbage transported to landfills. The TOL is on a step towards reaching environmental sustainability and should continue to put efforts into waste reduction.

Evaluation

This research has various limitations and improves that could be made to increase validity or credibility. First, the definition of sustainability and the appropriate metrics for how environmentally sustainable the TOL is. Academics constantly debate what is the appropriate definition of sustainability because it is an idea that cannot be proven scientifically. The UN's MDG Goal 7 is an idea with goals that would lead to a longer-lasting world. Nobody can clearly define what a perfect sustainable society is. Suggestions and concepts on what sustainability may look like are the only references available to define sustainability. Not having a concrete criteria that is primarily facts with quantitative requirements to accept or reject a society as sustainability is a limitation. This limitation will most likely never be solved because sustainability varies for each region, as a result of varying resources, infrastructure, cultures, and etc.

The sampling method of convenience sampling also has many limitations, including: researcher bias, not an accurate representation of the population, and a lack of ability to draw a complete conclusion. However, the four recreation centres were not strategically chosen; the Solid Waste Coordinator provided access to the recreation centres and so was used for this study. A possible way to further limit a potential researcher bias would be to do a waste classification analysis of every recreation centre in the TOL. This leads to the next point of generalizability.

Some of the research included in this essay is from secondary sources. The credibility of the secondary sources used in this study can be questionable and bias, resulting in another limitation. However, primary data was used as much as possible, which include the waste composition data and government released census reports.

This research is not generalizable due to a small sample size and a short timeline. The waste classification analysis was completed in one day at four recreation centres. Thus, the data sample is too small to generalize any results to a greater context. One day of collection is not enough to provide a general trend of effectiveness of a program because this day could have been an exceptional or poor-performance day compared to others. To have a more accurate representation of the effectiveness of the *Responsible* program, this research should be extended to at least a six-month term where a weekly classification would be done from every recreation centre in the TOL. This essay is a starting step towards possible future research on the TOL's waste programs.

A possible extension of this research would be to look at the TOL's household waste system, and then to compare the results. It would be interesting to see the possible similarities or differences in results between the effectiveness of a corporate waste program, compared to a household waste program.

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Images

Recreation Centres in Township of Langley. N.d. Photograph. www.tol.ca, Township of Langley. Web. Aug 21 2012. < http://www.tol.ca/Parks-Recreation/Recreation-Centres>.

Appendix

Appendix I - E-mail explaining why multi-stream is used in TOL

Aug
27

to me

Hi ,

We use the multi-stream system for our corporate recycling program because our residential program is multi stream. When residents put out their curbside recycling they put mixed paper in the yellow bag, newsprint in the blue bag and containers in the blue box, and now food in the Green Can. We wanted residents to have a smooth transition when they came to our facilities. Having everything the same process makes it much easier. They have to sort out their materials at home and also in the public spaces in their communities.

Let me know if you have any other questions.

Thanks,

| Solid Waste Coordinator
Engineering Division | Township of Langley

Appendix II - Location of Waste Bins

W.C. Blair Waste Bin

Civic Facility Waste Bin

Walnut Grove Community Centre Waste Bin

Langley Events Centre Waste Bin

Appendix III - Signs of Each Category of Waste on the TOL Waste Bins

Appendix IV - Coffee Lids Attached to Cups

The following picture is from the Civic Facility in the "Garbage" bin.